

Other embodiments are directed to dual layered display assemblies for a computer terminal, such as a portable device (*e.g.*, a wireless terminal). The assembly includes: a first display; and a second display positioned under the first display. In operation, the first display is configured to provide text and/or visual data using pixels with sufficient optical transmissivity and/or transparency to allow a user to optically view through the first display to text and/or visual data on the underlying second display.

Still other embodiments are directed to wireless terminals. The wireless terminals include: (a) a housing configured to enclose a transceiver that transmits and receives wireless communications signals; (b) a first display in communication with the transceiver and held in the housing so that a corresponding first viewing surface is externally viewable; and (c) a second display in communication with the transceiver and held in the housing beneath the first display so that a corresponding second viewing surface is externally viewable, the second display disposed a further distance away from the first viewing surface of the first display. The wireless terminals are configured to concurrently present data on the first and second displays.

In certain particular embodiments, the first display may be configured as a substantially transparent (typically monochromatic) display and the second display may be configured as a color graphic display.

In certain embodiments, the first and second displays can be configured to interactively engage each other during operation. In addition, the wireless terminal may be configured to review an incoming communication signal and parse the signal into visual and text data segments and then present selected text data on the first display and visual data on the second display. The incoming communication signal may comprise a MMS ("multimedia content service" message) with at least one image and text, and wherein the wireless terminal is configured to review the message and direct the signal so that at least some of the text is presented on the first display while the at least one image is presented on the second display.

In certain embodiments, in operation, the first display may be configured to provide text and/or visual data using pixels with sufficient optical transmissivity and/or transparency to allow a user to optically view through the first display to text and/or visual data on the underlying second display. The first display may be configured to operate in a screensaver mode during periods of non-active use.

In particular embodiments, the first display may be configured to automatically optically block viewability therethrough to inhibit external viewing of the second display during periods of non-use. In addition or alternatively, the first display may be configured to electrically lock access to the second display by
5 providing a password restricted access entry region on the first display and optically blocking the remainder of the first display while the second display carries text and visual data thereon to inhibit unauthorized use of the device.

Other embodiments are directed to computer program products for selectively displaying text or visual data. The computer program product can include a computer
10 usable storage medium having computer-readable program code embodied in the medium. The computer-readable program code can include: (a) computer readable program code that is configured to receive a wireless communication signal in a wireless terminal; (b) computer readable program code that is configured to direct a first display to display text and/or visual data associated with the received wireless
15 communication signal; and (c) computer readable program code that is configured to concurrently direct a second display disposed under the first display to display text and/or visual data associated with the received wireless communication signal.

It is noted that features of embodiments of the invention as described herein may be methods, systems, computer programs or a combination of same although not
20 specifically stated as such. The above and other embodiments will be described further below.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a portable terminal having multiple layered
25 displays according to embodiments of the present invention.

Figure 2 is an exploded view of multi-layered displays according to embodiments of the present invention.

Figures 3-8 are exploded views of layered displays with exemplary display operation according to embodiments of the present invention.

30 **Figure 9** is a perspective view of a portable terminal having multiple adjacently positioned layered displays and a keypad entry according to embodiments of the present invention.

Figure 10 is a side view of a wireless terminal with dual layered displays according to embodiments of the present invention.

Figure 11 is a flow chart of operations that can be performed according to embodiments of the present invention.

5 **Figure 12** is a block diagram of an exemplary data processing system according to embodiments of the present invention.

DETAILED DESCRIPTION

10 The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers
15 refer to like elements throughout. It will be appreciated that although discussed with respect to a certain embodiment, features or operation of one embodiment can apply to others.

 In the drawings, the thickness or size of lines, layers, features, components and/or regions may be exaggerated for clarity. It will be understood that when a
20 feature, such as a layer, region or substrate, is referred to as being "on" another feature or element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another feature or element, there are no intervening elements present. It will also be understood that, when a feature or element is referred to as being "connected" or
25 "coupled" to another feature or element, it can be directly connected to the other element or intervening elements may be present. In contrast, when a feature or element is referred to as being "directly connected" or "directly coupled" to another element, there are no intervening elements present.

 The terms "comprises, comprising" and derivatives thereof, mean that the
30 recited feature, operation, integer, component, step, and the like is present but does not exclude or preclude the presence or addition of one or more alternative or different features, integers, steps, components or groups.

As used herein, the term "display device" is a device that is configured with a plurality of displays. The display device may be a "portable device" including portable communication devices such as a PALM PILOT, laptop, notebook or other portable computer including wireless and non-wireless terminal configurations. The
5 term "wireless terminal" may include, but is not limited to, a cellular wireless terminal with or without a multi-line display; a Personal Communications System (PCS) terminal that may combine a cellular wireless terminal with data processing, facsimile and data communications capabilities; a PDA (personal digital assistant) that can include a wireless terminal, pager, internet/intranet access, web browser, organizer,
10 calendar and/or a GPS receiver; and a conventional laptop and/or palmtop receiver or other appliance that includes a wireless terminal transceiver. Wireless terminals may also be referred to as "pervasive computing" devices and may be mobile terminals including portable radio communication equipment. Thus, the term "portable device" (which can also be referred to interchangeably as "a mobile terminal") includes all
15 portable equipment such as mobile telephones, pagers, and communicators, including, but not limited to, smart phones, electronic organizers, and the like.

Embodiments of the present invention will now be described in detail below with reference to the figures. **Figure 1** illustrates a wireless terminal device **10** that includes a housing **10h** and first and second displays **20, 30**, respectively. The device
20 **10** may also include other electronic components such as those shown in **Figure 10**, including a printed circuit board **40**, a transceiver **50**, and a battery **60**. In addition, the device **10** may also optionally include a keypad **75** (**Figure 9**). The first display **20** can also provide a protective barrier for the underlying second display **30**, with each display held in proximity by the housing **10h**. Using the "Z" dimension to
25 present data can increase the amount (typically twice the size) of visual area in a relatively limited perimeter or footprint (without requiring a slide out or added length in the "X and/or Y" dimension). The user can use natural optical focusing to adjust to a target viewing plane or focal point to view desired text or visual data on either or both of the displays **20, 30**.

30 In certain particular embodiments, the data displayed across the Z-spatial dimension on multiple layered displays may be configured to cooperate to provide a three-dimensional data presentation.

The two displays **20, 30** may be configured to abut or be held in close, but spaced apart, proximity. The two displays **20, 30** may be sized and configured to be aligned and substantially coextensive with each other. In other embodiments, one of the displays **20, 30** may be longer, wider and/or larger (or shorter, more narrow or smaller) than the other (not shown). In addition, the displays **20, 30** may be substantially the same size but may be misaligned side to side and/or top to bottom so that they are offset in the "X" and/or "Y" dimension (not shown). In addition, although shown as two (dual layered) displays, additional displays in additional layers may also be used, as long as the focal lengths and optical viewability are such that a user can view data on the different displays.

Referring again to **Figure 1**, the first display **20** has a first focal length F_1 while the second display **30**, that is located beneath the first display **20**, has a longer focal length F_2 , with respect to a user. The first and second displays **20, 30** can concurrently operate to present desired data. For example, as shown in **Figure 1**, the first display **20** has a first viewing surface that is positioned closer to the user and presents text or visual data (shown as "First Layer" with the number "1") while the second underlying display **30** also presents text and/or visual data (shown as "Second Layer" with the number "2") with the second layer of data presented a further distance away from the first viewing surface. Thus, data can be concurrently displayed to a user in at least two different "Z" or depth dimensions. In operation, a user can optically shift or adjust his/her focus and/or selectively view data on either or both displays, without requiring any hardware to shift the data into focus on the displays **20, 30**. Thus, for example, a user can look past the first display **20** to view and/or focus on data presented by the second display **30**.

In certain embodiments, the first display **20** can be configured to be sufficiently optically transparent, translucent or transmissive so as to allow a user to optically view the data on the second display **30** through the first display **20**. In particular embodiments, the first display **20** can be semi-transparent while the second display **30** can be a color graphic display. For example, the first display **20** can be substantially transparent with pixels that become semi-transparent during operation (such as when activated). The first display **20** may be monochromatic with up and/or down-lighted pixels that display textual (alphanumeric) data or information, messages, symbols, and the like. The first display **20** may be configured with pixels

that are semi-transparent and/or partially illuminated to allow a user to look past and/or through the active pixels to the underlying display 30. The first display 20 may operate with adjustable pixel illumination.

5 The second display 30 can be a (typically full) color graphic display with increased (typically relatively "high") resolution over that of the first display 20. The second display 30 can present images, pictures, video clips, menus, program icons, as well as text data. The second display 30 can be a 1/8 VGA display. The second display 30 may provide the primary display and be the primary carrier of information, options, navigational control, status locator, email access, or orientation tracking, and
10 the like. For example, the second display 30 may be configured to comprise a standard operating interface desktop type data format while the first display may be configured to present less data (or be less cluttered) with related and/or unrelated data.

In certain embodiments, the first and second displays 20, 30 can interactively engage. Thus, in certain embodiments, a user can edit/ read and/or write or draw text
15 on the first display 20 (such as on the primary outwardly facing top surface) and view simultaneously through the first display 20 to see the underlying second display 30 to view menu options, images next/previous action taken, and the like. In operation, depending on which display the user is focusing on, one display (providing an information layer) may be visually or optically perceived as more active or dominant
20 than the other. Using dual layered display configurations where a user can visually shift focus or select target viewing regions to view desired data on one or more of the displays 20, 30.

The interaction or visual cooperation between the two displays 20, 30 can be configured to provide three-dimensional features, *i.e.*, when selecting an item on a
25 menu on the second layered display 30, the icon or feature may optically pop-up or out in the "Z" direction toward the first display 20 and the user to be visually acknowledged or perceived as being active, highlighted and/or in active mode.

In particular embodiments, retrieving, editing, reading, viewing and sending data using one of the displays can be undertaken independently rather than
30 interactively.

For example, the first display 20 can activate, upon direction, demand and/or request, to communicate with the underlying display 30 to carry out certain actions (typically responsive and/or dependent on data on the second display 30). The first

display **20** may extract data from the data on the second display **30** to thereby present a subset of the data on the second display **30**. The first display **20** may also or alternatively provide certain predetermined actions such as display text data, messages, symbols or icons for certain actions (such as arrows, rings or other marking symbols). For example, as shown in **Figure 2**, the user can concurrently view the first and second displays **20, 30** (shown by the optic line drawn through the top display **20** and down to the second display **30**). The first display **20** can be used to select features or pixels of the data on the second display **30** to edit, enhance, enlarge, select an action or icon, deselect an action or icon, and the like. The first and second displays **20, 30** can communicate to save updates or inputs made on the first display **20** with data on the second display **30**. As shown, the first and/or display may include a "save" grid location. The first display can highlight a target function selectable on the second display **30** by "marking" an object using a symbol (ring, arrow, and the like) displayable on the first display **20** to select the option or object on the second display **30**. The first display **20** may be used to enlarge the text/font or image on the second display **30** to improve readability or clarity. Other examples of interactive and/or individual display operations will be described further below.

Referring to **Figure 3**, in certain embodiments, the first display **20** can provide a "screensaver" mode. In particular embodiments, the first display **20** can be configured to provide a desktop security "lock" feature **20l** by optically blocking optic viewing through the first display **20**. The first display **20** may turn black and/or illuminate substantially all pixels to inhibit viewing of data on the second display **30** (which may be active during this mode) during the lockout mode. The first display **20** may be configured to not illuminate or only partially illuminate pixels allowing password entry or otherwise be configured to accept user input of a password or "secret" activation action. The screensaver and/or lockout modes may automatically engage after a non-active interval and/or upon a request by the user.

Figure 4 illustrates that the first display **20** may be configured to provide text messages **20t** (incoming and/or outgoing) while the second display **30** provides a desktop menu of icons **30i** of application programs and/or services. In certain embodiments, the text message **20t** may comprise an auto-scrolling text message.

Figure 5 illustrates that the two displays can present selected related data for a message or digital communication. For example, the second display **30** can present

an image **30p** while the first display **20** presents text **20t** related to the image **30p**. The message may be a message with multiple different communication media, such as an MMS message, which can be parsed into separate media segments so that selected text is displayed on the first display **20** and the image(s), pictures and/or video clips can be downloaded and concurrently displayed on the second display **30**. **Figure 6** illustrates that the message or communication can be from a position (navigation or map routing/guiding) service. The message or communication can include text data and a geographical map image **30m** with related direction or other text, the map image **30m** can be displayed on the second display **30** with certain (or all of the related text) presented on the first display **20**.

Figure 7 illustrates that the communication may be a digital book or article that can be electronically provided to a user using the wireless device **10**. In operation, corresponding text **30a₁** may be presented on the first display **20** while one or more related images **30a₂** from a scene, picture or video clip may be displayed on the second display **20**. The text may also be a news article or other copyrightable material with an appended image. For example, the user may subscribe to a news service that provides "breaking" news or short news summaries with the article or summary having multi-media text, audio and/or image or other visual components. The text may be presented in auto-scrolling format over the first display **20** with a video clip played behind the text on the second display **30**.

Figure 8 illustrates that a document **30d** may be presented on the second display **30** and the first display **20** can present extracted text **30e** from the document **30d** for viewing. The second display **20** may enlarge the extracted text **30e** and/or allow a user to edit the underlying document **30d**. The edited text can then be communicated to the second display and the record updated in memory accordingly.

Figure 10 is a side cross-sectional view of one embodiment of a portable device that can be configured as a wireless terminal **10** with the first display **20** and the second display **30** positioned to the left (above) a printed circuit board **40** and in communication with a transceiver **50** and battery **60**. A conventional arrangement of electronic components that allow a wireless terminal to transmit and receive wireless terminal communication signals will be described in further detail. Non-wireless configurations do not require the transceiver. An internal and/or external antenna associated with the wireless terminal device **10** is configured for receiving and/or

transmitting wireless terminal communication signals and is electrically connected to transceiver circuitry components **50**. The transceiver components can include a radio-frequency (RF) transceiver that is electrically connected to a controller such as a microprocessor. The controller can be electrically connected to a speaker that is
5 configured to transmit a signal from the controller to a user of a wireless terminal. The controller can also electrically connected to a microphone that receives a voice signal from a user and transmits the voice signal through the controller and transceiver to a remote device. The controller can be electrically connected to a keypad and the displays that facilitate wireless terminal operation. The design of the
10 transceiver, controller, and microphone are well known to those of skill in the art and need not be described further herein.

The wireless communication device **10** shown in **Figure 10** may be a radiotelephone type radio terminal of the cellular or PCS type, which makes use of one or more antennas according to embodiments of the present invention.

15 Antennas, according to embodiments of the present invention may be useful in, for example, multiple mode wireless terminals that support two or more different resonant frequency bands, such as world phones and/or dual mode phones. In certain embodiments, the wireless device **10** can operate in multiple frequency bands such as at least one low frequency band and at least one high frequency band. The terms “low
20 frequency band” or “low band” are used interchangeably and, in certain embodiments, include frequencies below about 1 GHz, and typically comprises at least one of 824-894 MHz or 880-960 MHz. The terms “high frequency band” and “high band” are used interchangeably and, in certain embodiments, include frequencies above 1 GHz, and typically frequencies between about 1.5-2.5 GHz. Frequencies in high band can
25 include selected ones or ranges within about 1700-1990 MHz, 1990-2100 MHz, and/or 2.4-2.485 GHz. The device **10** may be configured to support GPS and/or Bluetooth operations, as well as other positioning systems such as GALILEO, GONAS, and the like.

In certain embodiments, the device **10** may be configured to provide resonance
30 for a global positioning system (GPS) as the terminal **10** can include a GPS receiver. GPS operates at approximately 1,575 MHz. GPS is well known to those skilled in the art. GPS is a space-based triangulation system using satellites and computers to measure positions anywhere on the earth. Compared to other land-based systems,

GPS is less limited in its coverage, typically provides continuous twenty-four hour coverage regardless of weather conditions, and is highly accurate. In the current implementation, a constellation of twenty-four satellites that orbit the earth continually emit the GPS radio frequency. The additional resonance of the antenna as
5 described above permits the antenna to be used to receive these GPS signals.

The display(s) may be configured to operate with touchscreen input. Suitable software and associated locational grid hardware and operating structures are well known to those of skill in the art. *See e.g.* U.S. Patent No. 3,857,022 to Rebane et al., entitled *Graphic Input Device*; U.S. Patent No. 5,565,894 to Bates et al., entitled
10 *Dynamic Touchscreen Button Adjustment Mechanism*. The contents of these documents are hereby incorporated herein by reference as if recited in full. In certain embodiments, the wireless communication device **10** can include a touchscreen on the first display **20** and a keyboard or keypad entry **75** as shown in **Figure 9**. The keypad **75** may be an accessory item that may be added or removed depending on the set-up
15 desired by the user or OEM. Alternatively, the keypad **75** may be mounted on a flip member or configured to reside mounted on the housing **10h** over the first display **20**.

In particular embodiments, the displays **20, 30** can be sized and configured to cover a major portion of the area defined by a forward primary surface **10f** (**Figure 1**). The displays **20, 30** can be configured and sized to extend to cover about 75% or
20 more, and typically about 90% or more, of the forward surface **10f**.

Embodiments of the present invention are described below with reference to block diagrams and/or flowchart illustrations of methods, apparatus (systems) and/or computer program products according to embodiments of the invention. It is understood that each block of the block diagrams and/or flowchart illustrations, and
25 combinations of blocks in the block diagrams and/or flowchart illustrations, can be implemented by computer program instructions. These computer program instructions may be provided to a processor of a general purpose computer, special purpose computer, and/or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer and/or other programmable data processing apparatus, create means for implementing
30 the functions/acts specified in the block diagrams and/or flowchart block or blocks.

These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable data processing

apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instructions which implement the function/act specified in the block diagrams and/or flowchart block or blocks.

5 The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer-implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the
10 functions/acts specified in the block diagrams and/or flowchart block or blocks.

 It should also be noted that in some alternate implementations, the functions/acts noted in the blocks may occur out of the order noted in the flowcharts. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order,
15 depending upon the functionality/acts involved.

Figure 11 is a block diagram of exemplary embodiments of display formats that illustrate systems, methods, and/or computer program products in accordance with embodiments of the present invention. As shown, a wireless device receives a wireless communication signal having text, audio and/or visual data (block 100). The
20 communication signal is directed so that a portion of the communication signal data is presented on a first display having a first focal length (block 120) and so that at least a portion of the communication signal is presented on a second display in the wireless device underlying the first display (block 140). The communication signal may be a multi-media message having image and text data (block 115) and text data can be
25 displayed on the top display with the related image displayed concurrently on the lower second display (block 142).

Figure 12 is a block diagram of exemplary embodiments of data processing systems that illustrates systems, methods, and/or computer program products in accordance with embodiments of the present invention. The processor 310
30 communicates with the memory 314 via an address/data bus 348. The processor 310 can be any commercially available or custom microprocessor. The memory 314 is representative of the overall hierarchy of memory devices containing the software and data used to implement the functionality of the data processing system 305. The

memory 314 can include, but is not limited to, the following types of devices: cache, ROM, PROM, EPROM, EEPROM, flash memory, SRAM, and DRAM.

As shown in **Figure 12**, the memory 314 may include several categories of software and data used in the data processing system 305: the operating system 352; the application programs 354; the input/output (I/O) device drivers 358; an automated dual layered display communication/interactive presentation module 350 that directs the interaction of the two displays and/or which of the two displays to use to present selected data on; and data 356.

The data 356 may include incoming and/or outgoing communication signal data 362. As will be appreciated by those of skill in the art, the operating system 352 may be any operating system suitable for use with a data processing system, such as OS/2, AIX or OS/390 from International Business Machines Corporation, Armonk, NY, WindowsXP, WindowsCE, WindowsNT, Windows95, Windows98 or Windows2000 from Microsoft Corporation, Redmond, WA, PalmOS from Palm, Inc., MacOS from Apple Computer, UNIX, FreeBSD, or Linux, proprietary operating systems or dedicated operating systems, for example, for embedded data processing systems.

The I/O device drivers 358 typically include software routines accessed through the operating system 352 by the application programs 354 to communicate with devices such as I/O data port(s), data storage 356 and certain memory 314 components and/or the image acquisition system 320. The application programs 354 are illustrative of the programs that implement the various features of the data processing system 305 and preferably include at least one application that supports operations according to embodiments of the present invention. Finally, the data 356 represents the static and dynamic data used by the application programs 354, the operating system 352, the I/O device drivers 358, and other software programs that may reside in the memory 314.

While the present invention is illustrated, for example, with reference to the Dual Layered Display Module 350 being an application program in **Figure 12**, as will be appreciated by those of skill in the art, other configurations may also be utilized while still benefiting from the teachings of the present invention. For example, the Module 350 may also be incorporated into the operating system 352, the I/O device drivers 358 or other such logical division of the data processing system 305. Thus,

the present invention should not be construed as limited to the configuration of **Figure 12**, which is intended to encompass any configuration capable of carrying out the operations described herein.

5 The I/O data port can be used to transfer information between the data processing system **305** and a computer network **320** (*e.g.*, the Intranet or Internet) or another computer or communication system or other device controlled by the processor. These components may be conventional components such as those used in many conventional data processing systems, which may be configured in accordance with the present invention to operate as described herein.

10 In the drawings and specification, there have been disclosed embodiments of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims. Thus, the foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although a few
15 exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. In the claims, means-plus-
20 function clauses, where used, are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other
25 embodiments, are intended to be included within the scope of the appended claims. The invention is defined by the following claims, with equivalents of the claims to be included therein.